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NEMATODE PARASITISM OF COTTON. I.

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Cotton: There are four domesticated species of cotton in the genus *Gossypium*, family Malvaceae. The common upland cotton, *Gossypium hirsutum*, accounts for the bulk of the cotton fiber produced in this country. The long staple pima cotton, *G. barbadense*, also contributes to American production and, until recently, the long staple sea island cotton, also a *G. barbadense* cotton, contributed to American production but its cultivation on the sea islands of Georgia and South Carolina has been abandoned. *Gossypium hirsutum* and *G. barbadense* are allotetraploids making their genetics somewhat complex and the art of breeding cotton more difficult than is the case for simple diploid plants. The other domesticated cottons, *G. arboreum* and *G. herbaceum* are diploids but they are not grown extensively in this country.

Florida Cotton Production: Florida is not considered a major cotton producing state. Because it is not a major producer, data compiled annually by the Cotton Disease Council on total state yields and estimated crop losses due to diseases and nematodes are not available. However, the adjacent states of Alabama and Georgia are major producers and they annually estimate crop losses due to nematodes at more than 2 and 3% respectively, of the potential crop (Table 1) for the past 5 years. It is reasonable to suggest from these data that Florida cotton crop losses, especially losses in north Florida and the panhandle, could also be on the order of 2-3%.

The loss estimates published by the National Cotton Council are professional albeit subjective and reflect the magnitude of crop losses that occurred during the past growing season. It is interesting to note that the cotton Council report combines the estimated losses due to all nematodes into one reporting group--"NEMATODE SPP." Because nematode parasites of cotton have many features in common with one another, there may be some rationale to reporting losses due to all nematodes under a single reporting group.

Nematode parasites of cotton: Of the many nematodes that parasitize cotton, the root-knot nematode, *Meloidogyne incognita*, and the reniform nematode, *Rotylenchulus reniformis*, are probably the most damaging of all nematodes to cotton production; therefore, cotton parasitism by the two parasites will be discussed in succeeding circulars. The lesion nematode, *Pratylenchus* spp., sting nematode, *Belonolaimus longicaudatus*, and the lance nematode, *Hoplolaimus columbus*, are also associated with economic losses to cotton especially in the sandy soils of the Atlantic coast.

Characteristics of Plant Parasitic Nematodes: Juvenile plant parasitic soil-borne nematodes usually inhabit the film of water that surrounds soil particles if ectoparasitic feeders, or prior to root invasion if endoparasites. The juvenile stages of nematodes are usually, but incorrectly, called larvae (since the juvenile stage does not metamorphose into the adult stage, the term "larva" is misused). Juvenile plant parasitic nematodes are usually less than 1 mm long, and, thus, are too small to be seen with the unaided eye.

All nematodes parasitic on higher plants are equipped with a stylet. The stylet is a small, retractable, hypodermic needle-like structure located in the head of the animal. The nematode obtains its nourishment by inserting the stylet into a host cell and sucking out the cell contents. Since almost all plant parasitic nematodes are obligate parasites (i.e., obligate parasites must have living cells from which to obtain the nourishment to complete the life cycle) it is not always in the interest of the nematode, especially sedentary endoparasites, to kill the plant that it is feeding upon, because if the plant dies and the nematode cannot move to a new feeding site, the nematode will perish.

Nematode Life Cycle: Fig. 1 is an illustration of a nematode life cycle. Most nematodes reproduce by laying eggs. Depending on the nematode species, a single female nematode may deposit as many as 1,000 eggs in the soil. An embryonic nematode develops into a first stage juvenile within the egg; the first stage nematode sheds its cuticle (the outer body wall) while still within the egg and becomes a second stage juvenile. The second stage juvenile hatches from the egg and migrates through the soil to a host root. Several additional molts (shedding of the cuticle) occur either while the nematode is migrating through the soil or after the nematode begins feeding.

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The nematode's life cycle is completed when the female nematode lays eggs. Depending on the nematode species and the environmental conditions, several life cycles (generations) may be completed in a single growing season. Thus, it is easy to understand how a rapid increase in the population of a nematode can occur.

Reproductive Index: The extent to which a nematode reproduces on a plant is defined as the reproductive index. If the nematode reproduces aggressively on a plant, that plant is described as a "suitable" host, and by an extension in reasoning, such a host may be considered susceptible. The reproductive index "R" is derived from the equation $R= P_f/P_i$ where P_f is the number of nematode units (eggs, juvenile and adult nematodes) recovered after a specified time and temperature of incubation; P_i is the number of nematode units used to inoculate the plant. Greater R values presumably indicate proportionally greater susceptibility than lower R values.

Crop Losses: Regardless of the nematode species involved in a parasitic situation, the critical factors regulating the magnitude of crop loss seems to be the nature of the host plant and the number of nematodes present in the soil. For many crop/nematode combinations, a direct relationship exists between the number of nematodes in the soil and the amount of damage the plant sustains.

Nematode Management: Nematode management is based upon chemical or cultural practices that have the same fundamental objective--to reduce the population of nematodes in the soil. In recent years, this was best done with synthetic chemicals. Two broad types of synthetic chemicals evolved for nematode management--fumigant and contact poisons. However, for environmental considerations or the concern for human health, the use of most fumigant nematicides has been greatly reduced. Today there are few synthetic chemical nematicides available on the commercial market.

Among the cultural practices most often used to manage nematode problems are crop rotations and the use of resistant plants. Crop rotation works best on nematodes that have few hosts. Attempts are being made to combine chemical and cultural strategies by developing plants that synthesize chemicals that inhibit the reproduction of nematodes. Here too, the objective is to reduce the nematode population.

Nematode Resistant Cotton: Presently, there are no commercially available cultivars of cotton shown resistant to major nematode parasites, however, some cultivars have tolerance to nematode attack producing a crop in spite of the pest.

Table 1. Estimated Alabama and Georgia cotton crop losses (in bales) due to nematodes (1985-1989)*.

Year	Alabama	Georgia
1985	10124	10439
1986	10189	15984
1987	7407	8372
1988	8604	11365
1989	8190	14967

*Extracted from the Cotton Disease Council Loss Estimate Committee Reports (see the respective Annual Proceedings, Beltwide Cotton Production Research Conferences, National Cotton Council, P.O. Box 122385, Memphis, Tennessee).

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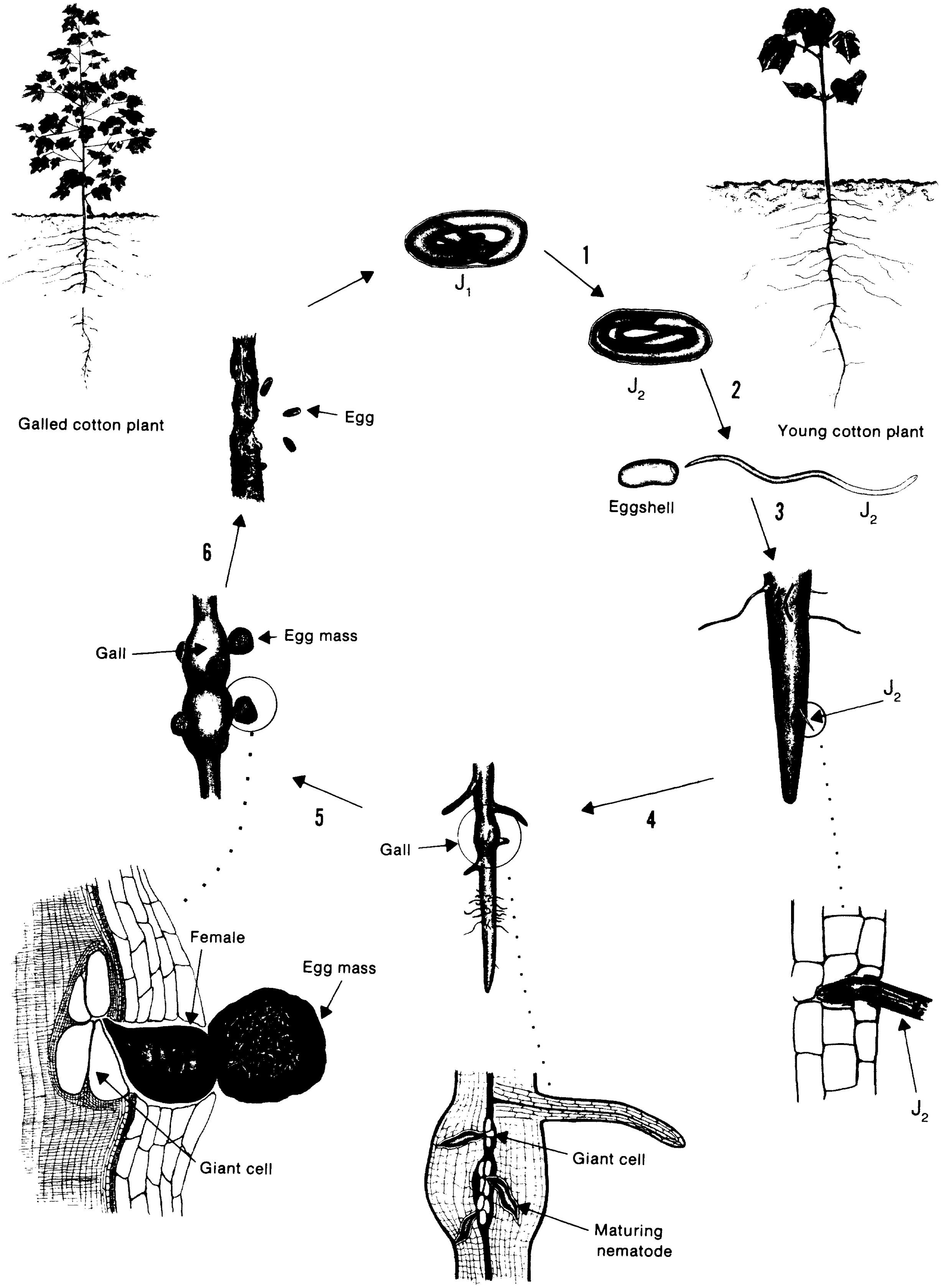

Fig. 1. Life cycle of a typical nematode parasite of cotton. As illustrated: The root-knot nematode, *Meloidogyne incognita*, parasitizing cotton. From: Watkins, G.M. (ed) 1981. Compendium of cotton diseases, Nematodes. Pp. 50-56. The American Phytopathological Society, St. Paul, Minnesota, by permission.